

IS : 4158 - 1986

Indian Standard

(Reaffirmed 2011)

(Reaffirmed 2016)

**SPECIFICATION FOR
SOLID EMBEDDED TYPE ELECTRIC
HEATING ELEMENTS**

(First Revision)

UDC 621.315.551



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INDIAN STANDARD INSTITUTION

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG

NEW DELHI 110002

Indian Standard
SPECIFICATION FOR
SOLID EMBEDDED TYPE ELECTRIC
HEATING ELEMENTS
(*First Revision*)

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Indian Standard
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0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 25 June 1985, after the draft finalized by the Electrical Appliances Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard was first published in 1967. The present revision has been undertaken to align this standard with IS : 302-1979* which is primarily based on the latest IEC Publication. For the sake of convenience of reference, the format of the standard has been modified to bring in line with IEC Publications on household electrical appliances.

0.3 Solid embedded type heating elements are largely used in hot-plates. Though they also find application in autoclaves, electric irons, etc, however, this specification prescribes requirements and tests mainly for elements for hot-plates.

0.4 This standard is to be read in conjunction with IS : 302-1979*. For the sake of convenience, the clauses of this standard correspond to those of IS : 302-1979*. Instead of reproducing full text of each clause, clauses of IS : 302-1979* which are applicable (which means that relevant provisions of the clause apply) or not applicable and the sub-clauses or portions thereof which are not applicable are indicated as under:

- a) In case of a clause where it is applicable or not applicable, the wording used is 'This clause of IS : 302-1979 is applicable/not applicable'.
- b) In case of a sub-clause or part thereof 'Not applicable'.

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Wherever a sub-clause of IS : 302-1979* is to be replaced by a new text, it has been indicated as under:

'Replacement — followed by the new text'.

Any addition to the existing provisions of a sub-clause of IS : 302-1979* has been indicated as under:

'Addition — followed by the text of the additional matter'.

Clauses/tables which are additional to those of IS : 302-1979* are numbered starting from 101 and additional sub-clauses are numbered with the main clause number followed by 101, 102, etc, for example 7.101.

Additional appendices have been numbered starting from AA.

Should however any deviation exist between IS : 302-1979* and this standard, the provisions of the latter shall apply.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

This clause of IS : 302-1979* is applicable except as follows:

1.1 Replacement — This standard covers the solid embedded type elements in cast iron or any other suitable metal preformed to receive the heating spiral together with the embedding material and having maximum loading of 5 kW.

1.4 Replacement — This standard covers the general, safety constructional and performance requirements and methods of tests and takes into account the influence on safety of components necessary to achieve required degree of radio and television interference suppression.

2. TERMINOLOGY

This clause of IS : 302-1979* is applicable except as follows:

2.6 to 2.8, 2.11, 2.17 to 2.19, 2.22, 2.23, 2.25 and 2.26 not applicable.

2.29 Conditions of Adequate Heat Discharge — Conditions of operation of the element similar to those specified in relevant individual appliance specification.

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†Rules for rounding off numerical values (*revised*).

2.30, 2.31, 2.33, 2.34, 2.46, and 2.47 not applicable.

Additional sub-clauses

2.101 Solid Embedded Type Element — An element in which the heating spiral is insulated from the metal body by embedding material and this material is open to atmosphere.

2.102 Metal Body — The metal part of the element which gets heated by the heat given out from the spiral and transmits this heat to the object to be heated. It may be cast or preformed out of sheet metal.

2.103 Heating Spiral — The current carrying part of the element having high resistance and which is the source of heat.

2.104 Embedding Material — The insulating material which envelopes the heating spiral and retains it in the metal body.

3. GENERAL REQUIREMENTS

This clause of IS : 302-1979* is applicable except as follows:

3.1 Para 2 not applicable.

4. GENERAL NOTES ON TESTS

This clause of IS : 302-1979* is applicable except as follows:

4.7 to 4.10, 4.13 and 4.14 not applicable.

5. RATING

This clause of IS : 302-1979* is applicable except as follows:

5.1 Replacement — The rated voltage shall not exceed 250 V. The preferred voltage shall be 240 V.

5.2.2 Not applicable.

6. CLASSIFICATION

This clause of IS : 302-1979* is applicable except as follows:

6.1 (a) (2), 6.1 (a) (3), 6.1 (b) (3) and 6.1 (b) (4) not applicable.

7. MARKING

This clause of IS : 302-1979* is applicable except as follows:

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7. Replacement

- a) Name of the manufacturer, trade-mark or identification mark,
- b) Rated voltage in volts,
- c) Rated input in watts or killowatts,
- d) Country of origin.

7.2, 7.3.1, 7.7 and 7.8 not applicable.

7.12 Replacement — An instruction sheet, giving necessary instructions including precautions to be taken for the proper use of heating element shall be provided.

Additional sub-clause

7.101 The heating element may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks), Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

8. PROTECTION AGAINST ELECTRIC SHOCK

This clause of IS : 302-1979* is applicable except as follows:

8.2 to **8.9** not applicable.

9. STARTING OF MOTOR OPERATED APPLIANCES

This clause of IS : 302-1979* is not applicable.

10. INPUT AND CURRENT

This clause of IS : 302-1979* is applicable except as follows:

10.2 and **10.3** not applicable.

11. TEMPERATURE-RISE

This clause of IS : 302-1979* is not applicable. The test shall be applicable to the appliance where the heating element is used.

Additional sub-clause

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11.101 Minimum Operating Temperature — The minimum operating temperature in still air and at the rated input at a point midway between the centre and the perimeter of the element shall not be less than 300°C.

12. OPERATION UNDER OVER LOAD CONDITIONS OF APPLIANCES WITH HEATING ELEMENT

This clause of IS : 302-1979* is applicable except as follows:

12.2 Replacement

The heating element is operated under conditions of adequate heat discharge, the supply voltage being such that the input is

1.33 times the rated input, for heating elements having a rated input not exceeding 100 W.

1.27 times the rated input or 1.21 times the rated input plus 12 W whichever is more for heating elements having a rated input exceeding 100 W.

The heating element is heated till the steady state conditions are established. If a self-resetting thermal cut-out or a non-self-resetting thermal cut-out which is accessible and can be reset without the aid of a tool operates, the operating period is considered to be ended. The heating element is then allowed to cool down and the cut-out is reset for the next cycle.

The heating element is subjected to 15 such heating cycles.

NOTE — Forced cooling may be used for the purpose of shortening the cooling period.

12.3 Not applicable.

13. ELECTRICAL INSULATION AND LEAKAGE CURRENT AT OPERATING TEMPERATURE

This clause of IS : 302-1979* is applicable.

14. RADIO AND TELEVISION INTERFERENCE SUPPRESSION

This clause of IS : 302-1979* is applicable.

15. MOISTURE RESISTANCE

This clause of IS : 302-1979* is applicable except as follows:

15.2.1, 14.2.2, 15.2.3, 15.2.4 and 15.3 not applicable.

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**16. INSULATION RESISTANCE AND ELECTRIC STRENGTH
(AFTER HUMIDITY TREATMENT)**

This clause of IS : 302-1979* is applicable except as follows:

16.3 not applicable.

17. OVERLOAD PROTECTION

This clause of IS : 302-1979* is not applicable.

18. ENDURANCE

This clause of IS : 302-1979* is applicable except as follows:

18.1 Paras 3 and 4 Replacement

The heating element shall be operated in air at 1.1 times rated input for 1 000 operating hours on cycles consisting of half-hour switching on followed by half-hour switching off. After every 100 hours water between 15°C and 40°C shall be poured on the element after the element has been switched off.

18.2 to 18.4 not applicable.

19. ABNORMAL OPERATION

This clause of IS : 302-1979* is applicable except as follows:

19.1 Para 2 (b) and (d), 5 and 6 not applicable.

19.2 Addition

Conditions without adequate heat discharge are obtained by testing the heating element on the floor of the test corner with the major axis approximately horizontal, in dry condition without applying any artificial means of cooling.

19.5 to 19.10 not applicable.

20. STABILITY AND MECHANICAL HAZARDS

This clause of IS : 302-1979* is applicable except as follows:

20.1 Replacement

Heating elements and their accessories shall have no sharp edge, burns or the like which might cause injury to the user, other than those necessary for the function of the heating element.

20.2 Not applicable.

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(*fifth revision*).

21. MECHANICAL STRENGTH

This clause of IS : 302-1979* is applicable except as follows:

21.4 not applicable.

Additional sub-clause

21.101 The heating element shall be allowed to fall from a height of 1 metre on to a rigidly supported base of hardwood 50 mm thick. The element shall be subjected to five falls from such a position that its major axis is approximately horizontal, and such that each impact occurs on a different part of the heating element. It shall then be subjected to five falls from such a position that its major axis is approximately vertical, with the heating element downwards. After the test, the appliance shall show no damage within the meaning of this specification, in particular live parts shall not have become accessible.

22. CONSTRUCTION

This clause of IS : 302-1979* is applicable except as follows:

22.4, 22.12, 22.15, 22.18, 22.20, 22.22, 22.24 to 22.27, 22.29 to 22.32 not applicable.

Additional sub-clause

22.101 Metal Body — It shall be made of a material that does not readily deteriorate during normal use for which it is designed. It may be made by casting or fabricated by welding or formed from sheet metal with the help of press tools.

22.102 Heating Spiral — It shall be made out of wire or ribbon of nickel chromium alloy, aluminium-iron alloy or a suitable heat resistant alloy, having a high electrical resistance.

22.103 Embedding Material — It shall be electrically insulating, thermally conducting, and fairly non-hygroscopic after the process of embedding is complete.

22.104 Terminal Connection — The leads of the heating spiral may be terminated at a terminal block suitable for electrical connections on the elements or may be brought out as flexible leads at least 15 cm long for direct connection on other terminals of the appliance on which the element is intended to be used.

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23. INTERNAL WIRING

This clause of IS : 302-1979* is applicable except as follows:

23.1, 23.4 to 23.8 not applicable.

24. COMPONENTS

This clause of IS : 302-1979* is applicable except as follows:

24.2 Replacement

Appliances shall not be fitted with:

- a) switches in flexible cables or cords;
- b) devices which, in the event of a fault in the appliance cause the interruption of the supply by applying a short circuit;
- c) thermal cut-outs that can be reset by a soldering operation; and
- d) self-resetting thermal cut-outs.

24.3 to 24.10 not applicable.

25. SUPPLY CONNECTIONS AND EXTERNAL FLEXIBLE CABLES AND CORDS

This clause of IS : 302-1979* is applicable except as follows:

25.1 Replacement

Heating element shall be provided with a means of connection to supply, in the form of a set of terminals or supply leads.

26. TERMINALS FOR EXTERNAL CONDUCTORS

This clause of IS : 302-1979* is applicable.

27. PROVISION FOR EARTHING

This clause of IS : 302-1979* is applicable except as follows:

27.3 not applicable.

28. SCREWS AND CONNECTIONS

This clause of IS : 302-1979* is not applicable.

29. CREEPAGE DISTANCES AND CLEARANCES

This clause of IS : 302-1979* is applicable except as follows:

29.2 and 29.3 not applicable.

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30. RESISTANCE TO HEAT FIRE AND TRACKING

This clause of IS : 302-1979* is applicable.

31. RESISTANCE TO RUSTING

This clause of IS : 302-1979* is applicable.

32. RADIATION HAZARDS

This clause of IS : 302-1979* is applicable.

33. FINISH

This clause of IS : 302-1979* is applicable.

Additional Clauses

101. TEST FOR METAL BODY

The body of the element shall not crack when the following test is carried out:

The element shall be heated for four hours at 1.1 times input wattage (protective device; if any, may be left in circuit). A ring 40 mm high and covering half the surface area of the element shall be placed concentrically on the hot plate. A tripod shall be placed over the element and a funnel with an opening of 5 mm at the pouring spout shall be placed over the tripod so that the 5 mm opening is 20 mm above the surface on the element and the spout is at the centre of ring. Water shall be poured in the funnel suddenly till the ring gets full. Water which leaks out from the bottom of the ring will crack the body if the body is of defective material or has constructional defect. This procedure shall be carried out three times and if the body does not crack it shall be deemed to have passed the test.

102. EFFICIENCY TEST

The element shall be placed on 2.5 cm thick asbestos sheet. A pan shall be positioned centrally over the heating surface and it shall have sufficient area to cover the heating surface. The dimensions of the pan shall not exceed the dimensions of the heating surface by more than 10 mm. The pan shall be of normal, not brightly polished aluminium, the bottom surface being flat to within 0.05 mm.

The capacity of the pan shall be 3.0 litres per kilowatt rating and shall contain 1.5 litres per kilowatt rating of initially cold water, evaporation losses being made up as necessary.

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The thermal efficiency when measured in accordance with Appendix AA shall not be less than 75 percent.

103. TESTS

103.0 Categories of Tests — Tests are classified as type, acceptance and routine tests.

103.1 Type Tests — The tests specified in Table 101 shall constitute the type tests and shall be carried out on two samples of heating elements of the same type and rating selected preferably at random from a regular production lot. Before commencement of the tests, the heating elements shall be visually examined and inspected for obvious visual defects in respect of components, parts and their assembly, construction, mechanical hazards, markings, provision of suitable terminals for supply connections, earthing and the effectiveness of screws and connections. The external surface finish shall be even and free from finishing defects.

103.1.1 Criteria of Acceptance — Both samples shall successfully pass all the type tests for proving conformity with the requirements of the standard. If any of the samples fails in any of the type tests, the testing authority, at its discretion, may call for fresh samples not exceeding twice the original number and subject them again to all test(s) or to the test(s) in which failure(s) had occurred. No failure should be permitted in the repeat test(s).

103 Acceptance Tests — The following shall constitute the acceptance tests:

<i>Test</i>	<i>Clause Reference</i>
a) Protection against electric shock	8
b) Input	10
c) Temperature rise	11
d) Electrical insulation and leakage current at operating temperature	13
e) Moisture resistance	15
f) Insulation resistance and electric strength (after humidity treatment)	16
g) Earthing connection	27
h) Test for metal body	101

NOTE — For the purpose of acceptance tests, the humidity treatment shall be done for 24 hours while conducting the test for moisture resistance (15).

103.2.1 A recommended sampling procedure for acceptance tests is given in Appendix B of IS : 302-1979*.

TABLE 101 SCHEDULE FOR TYPE TEST

(Clause 103.1)

SL NO.	CLAUSE REFERENCE
i) Protection against electric shock	8
ii) Input	10
iii) Temperature-rise	11
iv) Operation under overload conditions	12
v) Electrical insulation and leakage current at operating temperature	13
vi) Moisture resistance	15
vii) Insulation resistance and electric strength (after humidity treatment)	16
viii) Endurance	18
ix) Abnormal operation	19
x) Mechanical strength	21
xi) Cord grip and cord guard	25
xii) Earthing connections	27
xiii) Creepage distances and clearances	29
xiv) Resistance to heat, fire and tracking	30
xv) Resistance to rusting	31
xvi) Test for metal body	101
xvii) Efficiency test	102

103.3 Routine Tests — The following shall constitute the routine tests:

<i>Test</i>	<i>Clause Reference</i>
a) Protection against electric shock	8
b) High voltage	13.3.2 of IS : 302-1979*
c) Earthing connection	27

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A P P E N D I X A
TABLES OF TYPE TESTS

This appendix of IS : 302-1979* is not applicable.

A P P E N D I X B
(Clause 103.2.1)
SAMPLING PROCEDURE FOR ACCEPTANCE TESTS

This appendix of IS : 302-1979* is applicable.

A P P E N D I X C
ELECTRONIC CIRCUITS

This appendix of IS : 302-1979* is applicable if electronic circuits are used.

A P P E N D I X D
MEASUREMENT OF TEMPERATURE WITH THERMOMETER

This appendix of IS : 302-1979* is applicable.

A P P E N D I X E
ALTERNATIVE TESTS FOR PROTECTED MOTOR UNITS

This appendix of IS : 302-1979* is not applicable.

A P P E N D I X F
IMPACT TEST APPARATUS

This appendix of IS : 302-1979* is applicable.

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A P P E N D I X G

THERMAL CONTROLS AND OVERLOAD RELEASES

This appendix of IS : 302-1979* is not applicable.

A P P E N D I X H

MEASUREMENT OF CREEPAGE DISTANCES AND CLEARANCES

This appendix of IS : 302-1979* is applicable.

A P P E N D I X J

TEST FOR FIRE RESISTING PROPERTIES

This appendix of IS : 302-1979* is applicable.

A P P E N D I X K

BNF JET TEST FOR DETERMINATION OF THICKNESS OF COPPER AND NICKEL PLATING

This appendix of IS : 302-1979* is applicable if copper and nickel plating is used for finishing

A P P E N D I X L

APPROXIMATE MEASUREMENT OF THICKNESS OF CHROMIUM ON NICKEL, STEEL AND COPPER

This appendix of IS : 302-1979* is applicable if chromium plating is used for finishing.

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APPENDIX AA

(Clause 102)

TEST FOR THERMAL EFFICIENCY

AA-1. TEST PROCEDURE

AA-1.1 The test vessel containing 1.5 litres of water per kilowatt rating of the element, shall be placed centrally on the heating element. The initial temperature of the water shall be noted. The element shall be connected to source of supply, the circuit having been adjusted to give rated input.

AA-1.2 During the heating up period, water shall be continuously stirred and its temperature measured. When the water temperature is nearly 50°C above the initial temperature of the water, its temperature $T_2^\circ\text{C}$ just prior to the addition of an extra quantity of water as specified in **A-1.3** shall be accurately noted.

AA-1.3 A quantity of water equal to 0.75 litre per kilowatt rating of the element whose actual mass M in kg and initial average temperature $T_1^\circ\text{C}$ are accurately known, shall then be poured into the test vessel, and the heating continued, measurement of electrical input energy in kilowatt hours having begun from this instant. The heating and stirring shall be continued till the whole mass of water again reaches the temperature $T_2^\circ\text{C}$ when the measurement of input energy shall be discontinued. The electrical energy E consumed during this period in kilowatt hour is noted.

AA-1.4 The test shall be repeated with the test vessel rotated through 180° relative to its position in the first test.

AA-2. CALCULATION OF THERMAL EFFICIENCY

AA-2.1 The thermal efficiency, which is the ratio of heat absorbed by water to the heat equivalent of electrical energy supplied, expressed as a percentage shall be computed as follows:

$$\frac{MS (T_2 - T_1)}{860 \times E} \times 100$$

where

M = mass of water added and water equivalent of test vessel in kg.

S = specific heat of water in cal/deg,

T_2 = final temperature of the water,

T_1 = initial temperature of the water,

E = electrical energy input, and

860 = heat equivalent to 1 kWh of electrical energy.



INDIAN STANDARDS INSTITUTION

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones : 3 31 01 31, 3 31 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :

Telephone

*Western : Manakalaya, E9 MIDC, Marol, Andheri (East), 6 32 92 95
BOMBAY 400093

†Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, 36 24 99
Maniktola, CALCUTTA 700054

Southern : C. I. T. Campus, MADRAS 600113 41 24 42

Northern : B69 Phase VII, Industrial Focal Point, 8 73 28
S. A. S. NAGAR 160051 (Punjab)

Branch Offices :

'Pushpak', Nurmohamed Shaikh Marg, Khanpur, { 2 63 48
AHMADABAD 380001 { 2 63 49

'F' Block, Unity Bldg, Narasimharaja Square, 22 48 05
BANGALORE 560002

Gangotri Complex, Bhadbhada Road, T. T. Nagar, 6 27 16
BHOPAL 462003

22E Kalpana Area, BHUBANESHWAR 751014 5 36 27

5-8-56C L. N. Gupta Marg, HYDERABAD 500001 22 10 83

R14 Yudhister Marg, C Scheme, JAIPUR 302005 6 98 32

117/418 B Sarvodaya Nagar, KANPUR 208005 4 72 92

Patliputra Industrial Estate, PATNA 800013 6 23 05

Hantex Bldg (2nd Floor), Rly Station Road, 32 27
TRIVANDRUM 695001

Inspection Office (With Sale Point) :

Institution of Engineers (India) Building, 1332 Shivaji Nagar, 5 24 35
PUNE 410005

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Bombay 400007

†Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep 27 68 00
Street, Calcutta 700072

Printed at Printograph, New Delhi, India